IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re US Appln. of : YOSHIYASU INOUE

U.S. Application Serial No. 09/478,198 Filed: January 5, 2000

Japanese Patent Appln. No.: 11-002545

Japanese Patent Appln. Filing Date : January 8, 1999

For : Method of Fabricating a Display Panel and Method of Relocating a Display Panel

VERIFICATION OF TRANSLATION

The Honorable Commissioner of Patents & Trademarks
Washington, DC 20231

Dear Sir:

The undersigned residing at Shine Bluding 5F, 40-4, Shiba 3-chome, Minato-ku, Tokyo, Japan declares:

(1) that I know well both the Japanese and English languages;

(2) that I translated the above-identified Japanese Application from Japanese to English;

(3) that the attached English translation is a true and correct translation of the above-identified Japanese Application to the best of my knowledge and belief; and

(4) that all statements made of my own knowledge are true and that all statements made on information and belief are with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 USC § 1001, and that such false statements may jeopardize the validity of the application or any patent issuing therefrom.

Date January 4, 2004 Signature H. Amano

Typed Name: HIROSHI AMANO

[Document Name] Patent Application

[File Reference] 74610300

[Filing Date] January 8, 1999

[Address] Kenji ISAYAMA, Commissioner, Patent Office

[International Patent Classification] B65G 49/06

[Title of the Invention] Method of Fabricating a Display Panel and Method of Relocating a Display Panel

[Number of Claims] 28

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[Prepayment Ledger Number] 025782

[Amount of Payment] 21000

[List of Attachment]

[Name of Attachment] Specification 1

[Name of Attachment] Set of Drawings 1

[Name of Attachment] Abstract 1

[Number of General Power of Attorney] 9606620

[Necessity of Proof] Necessary

[Document Name] Specification

[Title of the Invention] Method of Fabricating a Display Panel and Method of Relocating a Display Panel

[Claims]

[Claim 1] A method of fabricating a display panel, comprising a step taking longer time to be carried out per a unit number of display panels than that of the previous step, characterized in that the unit number of display panels to be processed in said step is greater than the unit number of display panels to be processed in the previous step.

[Claim 2] A method of fabricating a display panel, comprising a step taking longer time to be carried out per a unit number of display panels than that of the immediately after step, characterized in that the unit number of display panels to be processed in said step is greater than the unit number of display panels to be processed in the immediately after step.

[Claim 3] A method of fabricating a display panel, comprising a step taking longer time to be carried out per a unit number of display panels than that of the previous step and the immediately after step, characterized in that the unit number of display panels to be processed in said step is greater than the unit number of display panels to be processed in the previous step and the unit number of display panels to be processed in the immediately after step.

[Claim 4] A method of fabricating a display panel, comprising a step taking longer time to be carried out per a unit number of display panels than that of the previous step, characterized in that the unit number of display panels to be processed in said step is greater than the unit number of display panels output in the previous step.

[Claim 5] A method of fabricating a display panel, comprising a step taking longer time to be carried out per a unit number of display panels than that of the immediately after step, characterized in that the unit number of display panels output in said step is greater than the unit number of display panels to be

processed in the immediately after step.

[Claim 6] A method of fabricating a display panel, comprising a step taking longer time to be carried out per a unit number of display panels than that of the previous step and the immediately after step, characterized in that the unit number of display panels to be processed in said step is greater than the unit number of display panels output in the previous step and the unit number of display panels output in said step is greater than the unit number of display panels to be processed in the immediately after step.

[Claim 7] The method as set forth in claim 1, 3, 4 or 6, further including the relocation step of relocating display panels from a cassette used in the previous step and accommodating vertically display panels, into a cassette used in said step in the greater number than the number of display panels having been processed in the previous step.

[Claim 8] The method as set forth in claim 2, 3, 5 or 6, further including the relocation step of relocating display panels from a cassette used in said step and accommodating vertically display panels, into a cassette used in the previous step in the smaller number than the number of display panels having been processed in said step.

[Claim 9] The method as set forth in claim 7 or 8, wherein said relocation step includes:

the first step of upwardly taking a display panel out of a first cassette in which display panels are vertically stored, with said display panel being supported at upper and lower edges thereof;

the second step of supporting said display panel taken out of said first cassette, at lower and side edges thereof;

the third step of laterally transferring said display panel from a position above said first cassette to a position above a second cassette; and

the fourth step of supporting said display panel at upper and lower edges thereof and lowering said display panel into said second cassette.

[Claim 10] The method as set forth in claim 9, wherein a pitch at an upper edge of said display panel is compensated for when said display panel is supported at said upper edge thereof in said first step.

[Claim 11] The method as set forth in claim 9 or 10, wherein a pitch at a side edge of said display panel is compensated for in said first step.

[Claim 12] The method as set forth in any one of claims 9 to 11, wherein a first cassette including display panels therein is transferred into a panel-pick-up station by means of a cassette supply unit, and an empty first cassette from which display panels have been taken out is discharged by means of an empty-cassette discharging unit in said first step, and wherein an empty second cassette is supplied into a station wherein a display panel is to be accommodated, by means of an empty-cassette supplying unit, and a second cassette including display panels therein is discharge by means of a cassette discharging unit.

[Claim 13] The method as set forth in claim 12, wherein a display-panel relocation unit is located almost at a center of a display-panel relocation apparatus used in said relocation step, a cassette is supplied and discharge through an end of said apparatus, and an empty cassette is supplied and discharged through the other end of said apparatus.

[Claim 14] The method as set forth in claim 12 or 13, wherein said second cassette is rotated in a horizontal plane by 90 degrees before or after said fourth step.

[Claim 15] The method as set forth in any one of claims 12 to 14, wherein said first cassette is rotated in a horizontal plane by 90 degrees before or after said first step.

[Claim 16] The method as set forth in any one of claims 7 to 15, wherein cassettes having the same size are used.

[Claim 17] The method as set forth in claim 16, wherein there is used a cassette including a pair of frames, a plurality of shafts extending between said frames, and a pair of panel-supporting plates, at least one of said

panel-supporting plates being slidable along said shafts and being able to be fixed at any position.

[Claim 18] The method as set forth in any one of claims 1 to 17, wherein said first step is a step of introducing liquid crystal into a space formed between two substrates.

[Claim 19] A method of fabricating a display panel, comprising:

the first step of upwardly taking a display panel out of a first cassette in which display panels are vertically stored, with said display panel being supported at upper and lower edges thereof; the second step of supporting said display panel taken out of said first cassette, at lower and side edges thereof; the third step of laterally transferring said display panel from a position above said first cassette to a position above a second cassette; and the fourth step of supporting said display panel at upper and lower edges thereof and lowering said display panel into said second cassette.

[Claim 20] The method as set forth in claim 19, wherein a pitch at an upper edge of said display panel is compensated for when said display panel is supported at said upper edge thereof in said first step.

[Claim 21] The method as set forth in claim 19 or 20, wherein a pitch at a side edge of said display panel is compensated for in said first step.

[Claim 22] The method as set forth in any one of claims 19 to 21, wherein a first cassette including display panels therein is transferred into a panel-pick-up station by means of a cassette supply unit, and an empty first cassette from which display panels have been taken out is discharged by means of an empty-cassette discharging unit in said first step, and wherein an empty second cassette is supplied into a station wherein a display panel is to be accommodated, by means of an empty-cassette supplying unit, and a second cassette including display panels therein is discharge by means of a cassette discharging unit.

[Claim 23] The method as set forth in claim 22, wherein a display-panel relocation unit is located almost at a center of a display-panel relocation

apparatus used in said relocation step, a cassette is supplied and discharge through an end of said apparatus, and an empty cassette is supplied and discharged through the other end of said apparatus.

[Claim 24] The method as set forth in claim 22 or 23, wherein said second cassette is rotated in a horizontal plane by 90 degrees before or after said fourth step.

[Claim 25] The method as set forth in any one of claims 22 to 24, wherein said first cassette is rotated in a horizontal plane by 90 degrees before or after said first step.

[Claim 26] The method as set forth in any one of claims 19 to 25, wherein cassettes having the same size are used.

[Claim 27] The method as set forth in claim 26, wherein there is used a cassette including a pair of frames, a plurality of shafts extending between said frames, and a pair of panel-supporting plates, at least one of said panel-supporting plates being slidable along said shafts and being able to be fixed at any position.

[Claim 28] The method as set forth in any one of claims 19 to 27, wherein said display panel is a liquid crystal display panel.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The invention relates to a method of fabricating a display panel and a method of relocating a display panel, and more particularly to a method of fabricating a display panel such as a liquid crystal display panel and a method of relocating a display panel from a first cassette in which display panels are accommodated, to a second cassette.

[0002]

[Prior Art]

Electronic devices are generally designed to include a display panel for

displaying an output. A liquid crystal display among display panels is in particular widely used for a personal computer, a word processor and other similar apparatuses because of small power-consumption, small thickness, light weight, and ability of being driven at a low voltage.

As illustrated in Fig. 9 including a perspective view and a front view, a liquid crystal display panel is comprised of a TFT substrate 1 composed of glass, a color filter substrate 2 composed of glass, and a sealing material 3 coupling the substrates to each other so that there is formed a space in the range of 5 to 6 μ m therebetween. Liquid crystal is sealed within the space between the substrates. The liquid crystal display panel is formed with a cutout 4, which is not covered with the sealing material 3.

[0003]

Such a liquid crystal display panel is fabricated generally in accordance with steps illustrated in Fig. 2. First, a glass substrate is subject to a TFT substrate forming step 5 including steps of washing, drying, printing of an alignment film, rubbing, printing of a sealing material, and so on. Another glass substrate is subject to a color filter forming step 6 including steps of washing, drying, printing of an alignment film, rubbing, distributing spacers, and so on.

The thus fabricated TFT substrate 1 and color filter substrate 2 are coupled to each other so that a gap is formed therebetween, in a coupling step 7.

[0004]

The coupled glass substrates are diced in dicing step 8 into a plurality of liquid crystal display panels having a size, for instance, in the range of 12 to 15 inches. The dicing step is comprised of the steps of scribing both the TFT substrate 1 and the color filter substrate 2 by means of a diamond cutter, applying impact to the scribed substrates 1 and 2, and separating the substrates into liquid crystal display panels along scribed lines. The thus separated liquid crystal display panel has such a shape as illustrated in Fig. 9.

After the completion of the dicing step 8, liquid crystal is introduced

into a gap formed in each of the thus fabricated liquid crystal display panels, in a liquid crystal introducing step 9. The step 9 is carried out as follows. First, as illustrated in Fig. 11, a plurality of liquid crystal display panels P and a container 11 containing liquid crystal 10 therein are put in a vacuum chamber 12. Then, air in the vacuum chamber 12 is exhausted. When a pressure in the vacuum chamber 12 lowers to a sufficient degree, the liquid crystal display panels P are immersed into the liquid crystal 10 through the cut-outs 4 of the liquid crystal display panels P. Thereafter, air is introduced into the vacuum chamber 12 to thereby raise a pressure in the vacuum chamber 12 to an atmospheric pressure. As a result, the liquid crystal 10 is introduced into gaps in the liquid crystal display panels P due to capillarity and a difference in a pressure between the liquid crystal display panels P and the vacuum chamber 12.

[0005]

After the liquid crystal 10 has been introduced into the liquid crystal display panels in the step 9, the cutouts 4 of the liquid crystal display panels P are closed in a sealing step 13 to thereby hermetically seal the liquid crystal display 10. For instance, the sealing step 13 is comprised of sweeping the liquid crystal, coating resin sensitive to ultra-violet ray, and radiating ultra-violet ray. Thereafter, steps of polishing, attaching a deflecting plate, making inspection and so on are carried out, and thus, there is completed a liquid crystal display panel.

[0006]

In the above-mentioned steps, cassettes are employed for containing, transferring and processing display panels in each of the dicing step 8 and the subsequent steps. In general, cassettes employed in each of the steps are designed to have the same shape. The reason why cassettes having the same shape are employed in those steps is that if a cassette has to have different shapes for different liquid crystal display panels, it would not be possible to automate fabricating liquid crystal display panels, because liquid crystal display panels have different sizes. If liquid crystal display panels having different

sizes are to be fabricated in a fabrication line, those liquid crystal display panels are contained in a cassette by moving a partition plate in a cassette to thereby conform the cassette to the liquid crystal display panel in size.

[0007]

[Problem to be solved by the Invention]

However, the above-mentioned conventional method of fabricating a liquid crystal display panel is accompanied with the following problem.

In these days, a liquid crystal display panel has been requested to be large in a size because of variety in fields in which a liquid crystal display panel is used, and to have a smaller gap in order to ensure a wider angle of visibility and enhancement in responsibility. A larger size and a smaller gap in a liquid crystal display panel cause a step of introducing liquid crystal per a unit number of panels to take longer time than other steps. For instance, the step 9 of introducing liquid crystal takes time four to five times greater than time which the step 3 or 13 takes. Hence, it is quite necessary to shorten time which the step 9 takes.

In order to shorten time the step 9 takes, the number of apparatuses for introducing liquid crystal may be increased, for instance. However, those apparatuses are expensive. In addition, if those apparatuses are newly introduced into a fabrication line, a fabrication line and/or other fabrication steps might be modified accordingly.

[0008]

In view of the above-mentioned problem in the conventional method, it is an object of the present invention to provide a method of fabricating a display panel and a method of relocating a display panel both of which are capable of enhancing a fabrication yield in fabrication of display panels, in particular, shortening time which a step of introducing liquid crystal into a space formed between substrates takes.

[0009]

[Solution to the Problem]

In order to solve the above-mentioned problem, the present invention provides a method of fabricating a display panel, including a step taking longer time to be carried out per a unit number of display panels than that of the previous step, characterized in that the unit number of display panels to be processed in the step is greater than the unit number of display panels to be processed in the previous step.

[0010]

In accordance with the present invention, it is possible in fabrication of a liquid crystal display panel, for instance, to process liquid crystal display panels in a step of introduction of liquid crystal by the unit number greater than the unit number of liquid crystal display panels in a step of dicing, which is to be carried out immediately before the step of introduction of liquid crystal.

Hence, even if a conventional fabrication line is used as it is, it would not be necessary to increase the number of apparatuses for introducing liquid crystal into a space formed between substrates, and the fabrication line and other fabrication steps are not necessary to be modified. Hence, it would be possible to enhance an efficiency in fabrication steps of a liquid crystal display panel and in a fabrication line.

[0011]

The present invention further provides a method of fabricating a display panel, including a step taking longer time to be carried out per a unit number of display panels than that of the immediately after step, characterized in that the unit number of display panels to be processed in the step is greater than the unit number of display panels to be processed in the immediately after step.

[0012]

In accordance with the present invention, it is possible in fabrication of a liquid crystal display panel, for instance, to process liquid crystal display

panels in a step of introduction of liquid crystal by the unit number greater than the unit number of liquid crystal display panels in a step of sealing, which is to be carried out immediately after the step of introduction of liquid crystal.

Hence, even if a conventional fabrication line is used as it is, it would not be necessary to increase the number of apparatuses for introducing liquid crystal into a space formed between substrates, and the fabrication line and other fabrication steps are not necessary to be modified. Hence, it would be possible to enhance an efficiency in fabrication steps of a liquid crystal display panel and in a fabrication line.

[0013]

There is further provided a method of fabricating a display panel, including a step taking longer time to be carried out per a unit number of display panels than that of the previous step and the immediately after step, characterized in that the unit number of display panels to be processed in the step is greater than the unit number of display panels to be processed in the previous step and the unit number of display panels to be processed in the immediately after step.

[0014]

In accordance with the present invention, it is possible in fabrication of a liquid crystal display panel, for instance, to process liquid crystal display panels in a step of introduction of liquid crystal by the unit number greater than both the unit number of liquid crystal display panels in a step of dicing, which is to be carried out immediately before the step of introduction of liquid crystal and the unit number of liquid crystal display panels in a step of sealing, which is to be carried out immediately after the step of introduction of liquid crystal.

Hence, even if a conventional fabrication line is used as it is, it would not be necessary to increase the number of apparatuses for introducing liquid crystal into a space formed between substrates, and the fabrication line and other fabrication steps are not necessary to be modified. Hence, it would be possible to

enhance an efficiency in fabrication steps of a liquid crystal display panel and in a fabrication line.

[0015]

There is further provided a method of fabricating a display panel, including a step taking longer time to be carried out per a unit number of display panels than that of the previous step, characterized in that the unit number of display panels to be processed in the step is greater than the unit number of display panels output in the previous step.

[0016]

In accordance with the present invention, it is possible in fabrication of a liquid crystal display panel, for instance, to process liquid crystal display panels in a step of introduction of liquid crystal by the unit number greater than the unit number of liquid crystal display panels in a step of dicing, which is to be carried out immediately before the step of introduction of liquid crystal.

Hence, even if a conventional fabrication line is used as it is, it would not be necessary to increase the number of apparatuses for introducing liquid crystal into a space formed between substrates, and the fabrication line and other fabrication steps are not necessary to be modified. Hence, it would be possible to enhance an efficiency in fabrication steps of a liquid crystal display panel and in a fabrication line.

[0017]

There is further provided a method of fabricating a display panel, including a step taking longer time to be carried out per a unit number of display panels than that of the immediately after step, characterized in that the unit number of display panels output in the step is greater than the unit number of display panels to be processed in the immediately after step.

[0018]

In accordance with the present invention, it is possible in fabrication of a liquid crystal display panel, for instance, to process liquid crystal display

panels in a step of introduction of liquid crystal by the unit number greater than the unit number of liquid crystal display panels in a step of sealing, which is to be carried out immediately after the step of introduction of liquid crystal.

Hence, even if a conventional fabrication line is used as it is, it would not be necessary to increase the number of apparatuses for introducing liquid crystal into a space formed between substrates, and the fabrication line and other fabrication steps are not necessary to be modified. Hence, it would be possible to enhance an efficiency in fabrication steps of a liquid crystal display panel and in a fabrication line.

[0019]

There is further provided a method of fabricating a display panel, including a step taking longer time to be carried out per a unit number of display panels than that of the previous step and the immediately after step, characterized in that the unit number of display panels to be processed in the step is greater than the unit number of display panels output in the previous step and the unit number of display panels output in the step is greater than the unit number of display panels to be processed in the immediately after step.

[0020]

In accordance with the present invention, it is possible in fabrication of a liquid crystal display panel, for instance, to process liquid crystal display panels in a step of introduction of liquid crystal by the unit number greater than both the unit number of liquid crystal display panels in a step of dicing, which is to be carried out immediately before the step of introduction of liquid crystal and the unit number of liquid crystal display panels in a step of sealing, which is to be carried out immediately after the step of introduction of liquid crystal.

Hence, even if a conventional fabrication line is used as it is, it would not be necessary to increase the number of apparatuses for introducing liquid crystal into a space formed between substrates, and the fabrication line and other fabrication steps are not necessary to be modified. Hence, it would be possible to

enhance an efficiency in fabrication steps of a liquid crystal display panel and in a fabrication line.

[0021]

In the firstly, thirdly, fourthly or sixthly mentioned method, it is preferable that the method further includes the relocation step of relocating display panels from a cassette used in the previous step and accommodating vertically display panels, into a cassette used in the step in the greater number than the number of display panels having been processed in the previous step.

[0022]

In accordance with the above-mentioned method, in steps of fabricating a liquid crystal display panel, for instance, it is possible to use a conventionally used cassette in a dicing step, and increase the unit number of liquid crystal display panels to be processed in a step of introducing liquid crystal.

Hence, even if a conventional fabrication line is used as it is, it would not be necessary to increase the number of apparatuses for introducing liquid crystal into a space formed between substrates, and the fabrication line and other fabrication steps are not necessary to be modified. Hence, it would be possible to enhance an efficiency in fabrication steps of a liquid crystal display panel and in a fabrication line.

[0023]

In the secondly, thirdly, fifthly or sixthly mentioned method, it is preferable that the method further includes the relocation step of relocating display panels from a cassette used in the step and accommodating vertically display panels, into a cassette used in the previous step in the smaller number than the number of display panels having been processed in the step.

[0024]

In accordance with the above-mentioned method, in steps of fabricating a liquid crystal display panel, for instance, it is possible to use a conventionally used cassette in a sealing step, and increase the unit number of liquid crystal

display panels to be processed in a step of introducing liquid crystal.

Hence, even if a conventional fabrication line is used as it is, it would not be necessary to increase the number of apparatuses for introducing liquid crystal into a space formed between substrates, and the fabrication line and other fabrication steps are not necessary to be modified. Hence, it would be possible to enhance an efficiency in fabrication steps of a liquid crystal display panel and in a fabrication line.

[0025]

In the seventhly or eighthly mentioned method, it is preferable that the relocation step includes the first step of upwardly taking a display panel out of a first cassette in which display panels are vertically stored, with the display panel being supported at upper and lower edges thereof, the second step of supporting the display panel taken out of the first cassette, at lower and side edges thereof, the third step of laterally transferring the display panel from a position above the first cassette to a position above a second cassette, and the fourth step of supporting the display panel at upper and lower edges thereof and lowering the display panel into the second cassette.

[0026]

In accordance with the above-mentioned method, it is possible to relocate a plurality of display panels accommodated in a cassette at a time with upper, lower and side edges of a display panel being supported. This ensures that display panels can be relocated at a time without injuring surfaces of the display panels.

[0027]

It is preferable that, in the first step in the ninthly mentioned method, a pitch at an upper edge of the display panel is compensated for when the display panel is supported at the upper edge thereof.

[0028]

In accordance with the above-mentioned method, it is possible to

prevent display panels from being damaged, because it is possible to take display panels out of a cassette or accommodate display panels into a cassette after the display panels have been aligned to one another.

[0029]

It is preferable that, in the first step in the ninthly mentioned method, a pitch at a side edge of the display panel is compensated for in the first step.

[0030]

In accordance with the above-mentioned method, it is possible to prevent display panels from being damaged, because it is possible to accommodate display panels into a cassette after the display panels have been aligned to one another.

[0031]

It is preferable that, in the first step in the ninthly, tenthly or eleventhly mentioned method, a first cassette including display panels therein is transferred into a panel-pick-up station by means of a cassette supply unit, and an empty first cassette from which display panels have been taken out is discharged by means of an empty-cassette discharging unit in the first step, and wherein an empty second cassette is supplied into a station wherein a display panel is to be accommodated, by means of an empty-cassette supplying unit, and a second cassette including display panels therein is discharge by means of a cassette discharging unit.

[0032]

In accordance with the above-mentioned method, it is possible to automatically discharge an empty cassette from which display panels have been taken out, and automatically supply an empty cassette into which display panels are to be accommodated. This ensures efficient relocation of display panels.

[0033]

In the twelfthly mentioned method, it is preferable that a display-panel relocation unit is located almost at a center of a display-panel relocation

apparatus used in the relocation step, a cassette is supplied and discharge through an end of the apparatus, and an empty cassette is supplied and discharged through the other end of the apparatus.

[0034]

In accordance with the above-mentioned method, it is possible to have an area in which a cassette into which display panels have been accommodated is processed and an area in which an empty cassette is processed, when a display panel relocation apparatus is arranged into a fabrication line. Thus, an efficiency in a fabrication line can be enhanced.

[0035]

In the twelfthly or thirteenthly mentioned method, it is preferable that the second cassette is rotated in a horizontal plane by 90 degrees before or after the fourth step.

[0036]

In accordance with the above-mentioned method, it is possible to present choices in selecting a direction in which display panels are accommodated in a cassette.

[0037]

In the twelfthly, thirteenthly or fourteenthly mentioned method, it is preferable that the first cassette is rotated in a horizontal plane by 90 degrees before or after the first step.

[0038]

In accordance with the above-mentioned method, it is possible to present choices in selecting a direction in which display panels are taken out of a cassette.

[0039]

In the seventhly to fifteenthly mentioned methods, it is preferable that cassettes having the same size are used.

[0040]

In accordance with the above-mentioned method, it is possible to increase an efficiency in a fabrication process and in a fabrication line without preventing a fabrication line of a display panel being automated.

[0041]

In the sixteenthly mentioned methods, it is preferable that there is used a cassette including a pair of frames, a plurality of shafts extending between the frames, and a pair of panel-supporting plates, at least one of the panel-supporting plates being slidable along the shafts and being able to be fixed at any position.

[0042]

In accordance with the above-mentioned method, it is possible to accommodate a display panel having any size into a cassette, ensuring that it is possible to increase an efficiency in a fabrication process and in a fabrication line without preventing a fabrication line of a display panel being automated, when display panels having different sizes from one another are fabricated.

[0043]

In the first to seventeenthly mentioned methods, it is preferable that the first step is a step of introducing liquid crystal into a space formed between two substrates.

[0044]

In accordance with the above-mentioned method, even if a conventional fabrication line is used as it is, it would not be necessary to increase the number of apparatuses for introducing liquid crystal into a space formed between substrates, and the fabrication line and other fabrication steps are not necessary to be modified. Hence, it would be possible to enhance an efficiency in fabrication steps of a liquid crystal display panel and in a fabrication line.

[0045]

There is further provided a method of fabricating a display panel, including the first step of upwardly taking a display panel out of a first cassette

in which display panels are vertically stored, with the display panel being supported at upper and lower edges thereof; the second step of supporting the display panel taken out of the first cassette, at lower and side edges thereof; the third step of laterally transferring the display panel from a position above the first cassette to a position above a second cassette; and the fourth step of supporting the display panel at upper and lower edges thereof and lowering the display panel into the second cassette.

[0046]

In accordance with the above-mentioned method, it is possible to relocate a plurality of display panels accommodated in a cassette at a time with upper, lower and side edges of a display panel being supported. This ensures that display panels can be relocated at a time without injuring surfaces of the display panels.

[0047]

It is preferable that, in the first step in the nineteenthly mentioned method, a pitch at an upper edge of the display panel is compensated for when the display panel is supported at the upper edge thereof.

[0048]

In accordance with the above-mentioned method, it is possible to prevent display panels from being damaged, because it is possible to take display panels out of a cassette or accommodate display panels into a cassette after the display panels have been aligned to one another.

[0049]

It is preferable that, in the first step in the nineteenthly or twentiethly mentioned method, a pitch at a side edge of the display panel is compensated for in the first step.

[0050]

In accordance with the above-mentioned method, it is possible to prevent display panels from being damaged, because it is possible to

accommodate display panels into a cassette after the display panels have been aligned to one another.

[0051]

It is preferable that, in the first step in the nineteenthly, twentiethly or twenty-firstly mentioned method, a first cassette including display panels therein is transferred into a panel-pick-up station by means of a cassette supply unit, and an empty first cassette from which display panels have been taken out is discharged by means of an empty-cassette discharging unit in the first step, and wherein an empty second cassette is supplied into a station wherein a display panel is to be accommodated, by means of an empty-cassette supplying unit, and a second cassette including display panels therein is discharge by means of a cassette discharging unit.

[0052]

In accordance with the above-mentioned method, it is possible to automatically discharge an empty cassette from which display panels have been taken out, and automatically supply an empty cassette into which display panels are to be accommodated. This ensures efficient relocation of display panels.

[0053]

In the twenty-secondly mentioned method, it is preferable that a display-panel relocation unit is located almost at a center of a display-panel relocation apparatus used in the relocation step, a cassette is supplied and discharge through an end of the apparatus, and an empty cassette is supplied and discharged through the other end of the apparatus.

[0054]

In accordance with the above-mentioned method, it is possible to have an area in which a cassette into which display panels have been accommodated is processed and an area in which an empty cassette is processed, when a display panel relocation apparatus is arranged into a fabrication line. Thus, an efficiency in a fabrication line can be enhanced.

[0055]

In the twenty-secondly or twenty-thirdly mentioned method, it is preferable that the second cassette is rotated in a horizontal plane by 90 degrees before or after the fourth step.

[0056]

In accordance with the above-mentioned method, it is possible to present choices in selecting a direction in which display panels are accommodated in a cassette.

[0057]

In the twenty-secondly, twenty-thirdly or twenty-fourthly mentioned method, it is preferable that the first cassette is rotated in a horizontal plane by 90 degrees before or after the first step.

[0058]

In accordance with the above-mentioned method, it is possible to present choices in selecting a direction in which display panels are taken out of a cassette.

[0059]

In the nineteenthly to twenty-fifthly mentioned methods, it is preferable that cassettes having the same size are used.

[0060]

In accordance with the above-mentioned method, it is possible to increase an efficiency in a fabrication process and in a fabrication line without preventing a fabrication line of a display panel being automated.

[0061]

In the twenty-sixthly mentioned methods, it is preferable that there is used a cassette including a pair of frames, a plurality of shafts extending between the frames, and a pair of panel-supporting plates, at least one of the panel-supporting plates being slidable along the shafts and being able to be fixed at any position.

[0062]

In accordance with the above-mentioned method, it is possible to accommodate a display panel having any size into a cassette, ensuring that it is possible to increase an efficiency in a fabrication process and in a fabrication line without preventing a fabrication line of a display panel being automated, when display panels having different sizes from one another are fabricated.

[0063]

In the nineteenthly to twenty-seventhly mentioned methods, it is preferable that the first step is a step of introducing liquid crystal into a space formed between two substrates.

[0064]

In accordance with the above-mentioned method, even if a conventional fabrication line is used as it is, it would not be necessary to increase the number of apparatuses for introducing liquid crystal into a space formed between substrates, and the fabrication line and other fabrication steps are not necessary to be modified. Hence, it would be possible to enhance an efficiency in fabrication steps of a liquid crystal display panel and in a fabrication line.

[0065]

[Embodiments in accordance with the Invention]

Hereinbelow are explained a method of fabricating a display panel and a method of relocating a display panel both in accordance with an embodiment of the present invention. First, hereinbelow is explained an apparatus for relocating a display panel which apparatus is to be used in both of the methods, and then, further explained a relation between the apparatus and a line for fabricating a display panel.

As illustrated in Fig. 1, an apparatus for relocating a display panel, used in a method of fabricating a display panel and a method of relocating a display panel, is comprised of a unit 23 for transferring panel-containing cassettes 22a and 22b containing display panels 21 therein, a unit 25 for

transferring empty cassettes 24a and 24b containing no display panels, and a unit 26 for taking display panels 21 out of the panel-containing cassette 22a and inserting those display panels 21 into the empty cassette 24a. The unit 26 is arranged at the center of the apparatus for relocating a display panel. The unit 23 is arranged this side of the unit 26 in Fig. 1, and the unit 25 is arranged beyond the unit 26 in Fig. 1.

[0066]

The unit 23 is designed to include a unit 27 at the right in Fig. 1, and a unit 28 at the left in Fig. 1. The unit 27 supplies the panel-containing cassette 22a which contains the display panels 21 therein, to the unit 26. The unit 28 ejects the panel-containing cassette 22b into which the display panels 21 have been inserted in the unit 26.

The unit 27 includes a first station ST1 at which the panel-containing cassettes 22a temporarily stop when the unit 27 supplies the panel-containing cassettes 22a to the unit 26, a second station ST2, and a third station ST3. The panel-containing cassettes 22a are transferred through the first station ST1, the second station ST2, and the third station ST3 in this order. The panel-containing cassettes 22a are transferred by means of an intermittently-transferring unit, though not illustrated. Each of the first and second stations ST1 and ST2 is designed to include a cassette mount 29 on which the panel-containing cassette 22a is to be mounted, and the third station ST3 is designed to include a disc-shaped rotatable cassette rotary unit 30 on which the panel-containing cassette 22a can be horizontally turned. Though it is possible to rotate the cassette rotary unit 30 to thereby turn the panel-containing cassette 22a in the third station ST3, and transfer the panel-containing cassette 22a to the unit 26, the panel-containing cassette 22a may be transferred to the unit 26 without rotating the cassette rotary unit 30, namely, without turning the panel-containing cassette 22a.

[0067]

Similarly, the unit 28 includes a sixteenth station ST16 at which the panel-containing cassettes 22b temporarily stop when the unit 26 ejects the panel-containing cassettes 22b, a seventeenth station ST17, and an eighteenth station ST18. The panel-containing cassettes 22b are transferred through the sixteenth station ST16, the seventeenth station ST17, and the eighteenth station ST18 in this order in the unit 28. Thus, the panel-containing cassettes 22a are transferred in the unit 27 in a direction opposite to a direction in which the panel-containing cassettes 22b are transferred in the unit 28. Each of the seventeenth and eighteenth stations ST17 and ST18 is designed to include a cassette mount 29 on which the panel-containing cassette 22b is to be mounted, and the sixteenth station ST16 is designed to include a disc-shaped rotatable cassette rotary unit 30 on which the panel-containing cassette 22b can be horizontally turned.

[0068]

The unit 25 is designed to include a sixth unit 31 at the left in Fig. 1, and a unit 32 at the right in Fig. 1. The unit 31 supplies the empty cassettes 24a to the unit 26. The unit 32 ejects the empty cassette 24b from which the display panels 21 have been taken out in the unit 26.

The unit 31 has almost the same structure as that of the unit 27. Specifically, the unit 31 includes a tenth station ST10 at which the empty cassettes 24a temporarily stop when the empty cassettes 24a are supplied to the unit 26, an eleventh station ST11, and a twelfth station ST12 (not illustrated). The second or empty cassettes 24a are transferred through the tenth station ST10, the eleventh station ST11, and the twelfth station ST12 in this order. Similarly to the unit 27, each of the tenth and eleventh stations ST10 and ST11 is designed to include a cassette mount 29 on which the empty cassette 24a is to be mounted, and the twelfth station ST12 is designed to include a disc-shaped rotatable cassette rotary unit 30 on which the empty cassette 24a can be horizontally turned.

[0069]

Similarly, the unit 32 includes a seventh station ST7 at which the second or empty cassettes 24b temporarily stop when the unit 26 ejects the empty cassettes 24b, an eighth station ST8, and a ninth station ST9. The empty cassettes 24b are transferred through the seventh station ST7, the eighth station ST8, and the ninth station ST9 in this order in the unit 32. Thus, the empty cassettes 24a are transferred in the unit 31 in a direction opposite to a direction in which the empty cassettes 24b are transferred in the unit 32. Similarly to the unit 31, each of the eighth and ninth stations ST8 and ST9 is designed to include a cassette mount 29 on which the empty cassette 24b is to be mounted, and the seventh station ST7 is designed to include a disc-shaped rotatable cassette rotary unit 30 on which the empty cassette 24b can be horizontally turned.

[0070]

Hereinbelow is explained the unit 26 for relocating the display panels.

The unit 26 is comprised of a base 33 and a display panel relocating unit 34 incorporated into the base 33. As illustrated in Fig. 1, the unit 26 is inclined about 1 degree towards the unit 25. By arranging the unit 26 to incline about 1 degree towards the unit 25, the display panels 21 which vertically stand by virtue of gravitational force are all inclined in a direction, resulting in that the display panels 21 contained in the cassette are in a row at a constant pitch.

The base 33 includes, at the upper and right in Fig. 1, a unit 35 which transfers the panel-containing cassettes 22a and the empty cassettes 24b, and, at the upper and left in Fig. 1, a unit 36 which transfers the empty cassettes 24a and the panel-containing cassettes 22b.

The unit 35 includes a fourth station ST4, a fifth station ST5 (picking-out stationg) and a sixth station ST6. The panel-containing cassettes 22a are transferred through the fourth station ST4, the fifth station ST5 and the sixth station ST6 in this order by means of an intermittently-transferring unit. The fifth station ST5 includes a rectangular opening 37 through which a device

45 of a later mentioned unit 34 raises and lowers. The display panels 21 are taken out of the panel-containing cassette 22a in the fifth station ST5. Accordingly, after the display panels 21 are taken out of the panel-containing cassette 22a having been transferred from the fourth station ST4 to the fifth station ST5, the panel-containing cassette 22a is turned into the empty cassette 24b, which is then transferred to the sixth station ST6. Each of the fourth and sixth stations ST4 and ST6 is designed to include a cassette mount 29 on which the panel-containing cassette 22a or the empty cassette 24b is to be mounted. The fifth station ST5 includes a cassette feeder (not illustrated) which shifts the panel-containing cassette 22a in a pitch-wise direction of the display panel 21 or in a length-wise direction of the apparatus in the fifth station ST5. By shifting or relocating the panel-containing cassette 22a by means of the cassette feeder, the later mentioned unit 34 can increase or decrease the number of display panels 21 to be taken out of the panel-containing cassette 22a in one cycle.

[0071]

The unit 36 has almost the same structure as that of the unit 35. Specifically, the unit 36 includes a thirteenth station ST13, a fourteenth station ST14 (accommodation station) and a fifteenth station ST15. The empty cassettes 24a are transferred through the thirteenth station ST13, the fourteenth station ST14 and the fifteenth station ST15 in this order by means of an intermittently-transferring unit (not illustrated). The fourteenth station ST14 has a rectangular opening 38, similarly to the fifth station ST5. The display panels 21 are inserted into the empty cassette 24a by means of the later mentioned unit 34 in the fourteenth station ST14. Accordingly, after the display panels 21 are inserted into the empty cassette 24a having been transferred from the thirteenth station ST13 to the fourteenth station ST14, the empty cassette 24a is turned into the panel-containing cassette 22b, which is then transferred to the fifteenth station ST15. Similarly to the unit 35, each of the thirteenth and fifteenth stations ST13 and ST15 is designed to include a cassette mount 29 on

which the empty cassette 24a or the panel-containing cassette 22b is to be mounted. Similarly to the fifth station ST5, the fourteenth station ST14 includes a cassette feeder (not illustrated) which shifts or relocates the empty cassette 24a to thereby make it possible for the later mentioned unit 34 to increase or decrease the number of display panels 21 to be taken out of the empty cassette 24a in one cycle.

[0072]

The base 33 is designed to include a unit 39 at the center thereof between the fifth and fourteenth stations ST5 and ST14. The unit 39 detects the groove formed at a sidewall of the panel-containing cassette 22a or the empty cassette 24a having been stopped at the fifth or fourteenth station ST5 or ST14, by means of a sensor 40, to thereby compensate for a position at which the panel-containing cassette 22a or the empty cassette 24a have stopped. When the position is to be compensated for, the above-mentioned cassette feeder (not illustrated) shifts or relocates the panel-containing cassette 22a or the empty cassette 24a accordingly.

The unit 34 includes a support block 42 having two legs 42. A sweeper unit 43 is provided at each of the legs 42 for removing extra liquid crystal having been adhered to later mentioned rollers 62. Only one sweeper unit 43 is illustrated in Fig. 1 for simplification of Fig. 1. The sweeper unit 43 is explained later in detail. The base 33 further includes sweeper units 44 having the same structure as that of the sweeper unit 43, below the fifth and fourteenth stations ST5 and ST14. The sweeper unit 44 is explained later in detail.

[0073]

Hereinbelow is explained the unit 34 incorporated in the base 33.

As illustrated in Figs. 1 to 3, the unit 34 which relocates the display panels 21 is comprised of a display panel moving unit 45 which raises and lowers the display panel 21, a display panel feeder 46 equipped at a support block 41, a display panel support unit 47 coupled to the display panel feeder 46 for

supporting the display panel 21 at an upper edge thereof, a display panel holding unit 48, and a pitch compensating unit 49 for compensating for a pitch of a side edge of the display panel 21.

As illustrated in Figs. 6 (a perspective view) and 7 (a front view), the display panel moving unit 45 is comprised of a pair of roller guides 51 each including an upper roller and a lower roller both supporting the display panel, a unit 52 for adjusting a space between the upper and lower rollers supporting the display panel 21 at a lower edge of the panel, a unit 53 for rotating the roller guides 51, and a drive motor (not illustrated). The unit 53 for rotating the roller guides 51 transfers a drive force from the drive motor to rotation shafts 55 of the roller guides 51 through a timing belt TB to thereby rotate the roller guides 51. The display panel moving unit 45 is driven by a drive motor (not illustrated) to thereby laterally move between a position under the fifth station ST5 and a position under the fourteenth station ST14 along a groove of a lateral slide guide 57 formed at the base 33.

The display panel moving unit 45 supports the display panels 21 at lower edges thereof by means of the upper and lower rollers 50, when the display panels 21 are taken out of the panel-containing cassette 22a having stopped at the fifth station ST5, and is driven by a drive motor to thereby upwardly move to lift the display panels 21 up. The display panel moving unit 45 supports the display panels 21 at lower edges thereof by means of the upper and lower rollers 50, when the display panels 21 are inserted into the empty cassette 24a having stopped at the fourteenth station ST14, and is driven by a drive motor to thereby downwardly move to lower the display panels 21.

[0074]

Since a space between the upper and lower rollers 50 both making contact with lower edges of the display panels 21 can be adjusted by means of the unit 52 in the display panel moving unit 45, it is possible to lift the display panels 21 up at a position other than a cut-out formed at a lower edge of the display

panel 21, through which liquid crystal is introduced into the display panel 21. Accordingly, it would be possible for debris, dust and other foreign materials to adhere to the cut-out. As illustrated in Fig. 1, the base 33 is formed with the sweeper units 44 below the fifth and fourteenth stations ST5 and ST14. The sweeper units 44 are designed to have a roll of sweeping sheet 56. When extra liquid crystal is adhered to the upper and lower rollers 50, the unit 53 is operated to rotate the roller guides 51 by 180 degrees, and then, the unit 52 is operated to cause the roll of sweeping sheet 56 to make contact with the roller guides 51 for sweeping or absorbing extra liquid crystal having been adhered to the roller guides 51.

[0075]

The display panel feeder 46 is coupled to the lateral slide guide 57 of the support block 41 of the tenth unit 34, and is driven by a drive motor (not illustrated) to thereby laterally move a position above the fifth station ST5 and a position above the fourteenth station ST14 along a groove formed with the lateral slide guide 57.

The display panel feeder 46 includes the display panel support unit 47, the display panel holding units 48, and the pitch compensating units 49.

As illustrated in Fig. 2, the display panel support unit 47 is comprised of a pitch compensating unit 59 including two comb-shaped plates 58 overlapping each other. The comb-shaped plates 58 raise and lower along elongate grooves 60. As illustrated in Fig. 5, a plate 58a of the comb-shaped plates 58 slides relative to other plate 58b by a small distance.

The display panel holding units 48 and the pitch compensating units 49 are arranged at opposite sides of the display panel support unit 47 by two at one side. The display panel holding units 48 and the pitch compensating units 49 are designed to be able to laterally slide along the slide guide 61 of the display panel feeder 46. The display panel holding unit 48 is comprised of holders 64 each including a first roller 62 and a second roller 63, rotary units 65 each having

opposite ends at which the holders 64 are secured, and arms 66. The rotary unit 65 rotates the holders 64 in a horizontal plane about an axis 67.

As mentioned earlier, the base 33 is formed at the legs 42 of the support block 41 of the tenth unit 34 with the sweeper units 43 for sweeping extra liquid crystal having been adhered to the first roller 62. Fig. 1 illustrates only one sweeper unit 43 for the sake of simplification of Fig. 1. The sweeper unit 43 has almost the same structure as that of the earlier mentioned sweeper unit 44. When extra liquid crystal is adhered to the first roller 62 supporting the display panel 21 at a lower edge thereof, the rotary units 65 are operated to rotate the holders 64, and then, the arms 66 are caused to slide to thereby cause the roll of sweeping sheet 68 to make contact with the first rollers 62 for sweeping or absorbing extra liquid crystal having been adhered to the first roller 62.

The pitch compensating units 49 includes two comb-shaped plates 69 overlapping each other, similarly to the display panel support unit 47 illustrated in Fig. 5. A plate 69a of the comb-shaped plates 69 slides relative to a plate 69b by a small distance.

The display panel feeder 46 includes a unit (not illustrated) for positioning a cassette. The display panel feeder 46 detects an edge formed on a sidewall of the panel-containing cassette 22a or the empty cassette 24a having been stopped at the fifth or fourteenth station ST5 or ST14, by means of a sensor, from above, to thereby compensate for a position at which the panel-containing cassette 22a or the empty cassette 24a have stopped.

[0076]

Figs. 6(a) and 6(b) illustrates a cassette used in the above-mentioned apparatus for relocating display panels. The cassette illustrated in Fig. 6(a) constitutes the panel-containing cassette 22a and the empty cassette 24b. The cassette is also illustrated in Fig. 3 without a later mentioned lock unit 73. The cassette illustrated in Fig. 6(b) constitutes the panel-containing cassette 22b and

the empty cassette 24a illustrated in Fig. 1.

As illustrated in Fig. 6(a), each of the panel-containing cassette 22a and the empty cassette 24b is comprised of a pair of outer frames 70, a plurality of slide shafts 71 extending between the outer frames 70, and a pair of display panel holders 72 for supporting the display panels 21. Each of the display panel holders 72 is formed at opposite ends thereof with lock units 73 slidable along the slide shafts 71. The display panel holders 72 can be fixed at a desired position along the slide shafts 71 by locking the lock units 73. Hence, a space between the opposing display panel holders 72 can be varied in accordance with a size of the display panels 21, and thus, display panels having various sizes can be accommodated in the cassette.

As illustrated in Fig. 10, a perspective view, the display panel holder 72 is formed at a surface thereof with a plurality of grooves 74 each having a rectangular cross-section. The display panel 21 is inserted into the groove 74, and is supported at a termination end 75.

The panel-containing cassette 22b and the empty cassette 24a illustrated in Fig. 6(b) are designed to have the same outer shape as that of the panel-containing cassette 22a and the empty cassette 24b illustrated in Fig. 6(a). The display panel holder 72 is designed to be slidable in a length-wise direction of the cassette in the panel-containing cassette 22a and the empty cassette 24b illustrated in Fig. 6(a), whereas the display panel holder 72 is designed to be slidable in a direction perpendicular to a length-wise direction of the cassette in the panel-containing cassette 22b and the empty cassette 24a illustrated in Fig. 6(b).

[0077]

It should be noted that a position at which the panel-containing cassettes are supplied and a position at which the empty cassettes are ejected, that is, a position of the first station ST1 and a position of the eighteenth station ST18 shown in Fig. 1, respectively, are not to be limited to those shown in the

above-mentioned embodiment, but can be arranged in accordance with arrangement of areas in a fabrication line.

[0070]

Hereinbelow are explained a relation between a line of fabricating a display panel and the above-mentioned apparatus for relocating display panels in accordance with the embodiment, and an operation of the apparatus.

As illustrated in Fig. 8(a), which is a block diagram of a line of fabricating liquid crystal display panels, the apparatus for relocating display panels, illustrated in Fig. 1, is installed, for instance, as a relocation apparatus A and a relocation apparatus B in a relocation step area 84 positioned in the neighborhood of a dicing step area 81 where glass substrates are cut into a size of a liquid crystal display panel, a introduction step area 82 where liquid crystal is introduced into a liquid crystal display panel, and a sealing step area 83 where a cutout of a display panel through which liquid crystal has been introduced into a liquid crystal display panel is closed.

Each of the relocation apparatuses A and B has inlet ports 85 and 87 through which cassettes are introduced into the apparatuses and outlet ports 86 and 88 through which cassettes are drawn out of the apparatuses. The inlet ports 85, 87 and the outlet ports 86, 88 correspond to the first, tenth, eighteenth and ninth stations ST1, ST10, ST18 and ST9, respectively.

The relocation apparatus A receives two cassettes each including 40 liquid crystal display panels, fed from the dicing step area 81, and relocates totally 80 liquid crystal display panels to an empty cassette to be supplied to the introduction step area 82. The relocation apparatus B receives the cassette including 80 liquid crystal display panels, fed from the introduction step area 82, and relocates 40 liquid crystal display panels to each of two cassettes to be fed to the sealing step area 83.

[0078]

The above-mentioned operation carried out in the relocation step area

84 makes it possible to increase the number of liquid crystal display panels to be processed in a step of introducing liquid crystal into a liquid crystal display panel, without changing the number (that is, 40 in the above-mentioned case) of liquid crystal display panels having been conventionally processed in both a step of cutting substrates and a step of sealing liquid crystal displays. Thus, it is possible to enhance a fabrication yield in a line of fabricating liquid crystal display panels using a conventional fabrication line as it is, without increasing the number of apparatuses for introducing liquid crystal into a liquid crystal display panel, and further without exerting any influence on both other steps and a fabrication line.

With respect to a relation between the relocation apparatus and a display panel fabrication line, a single apparatus C of relocating display panels may be installed in the relocation step area 84, as illustrated in Fig. 8(b) which is a block diagram showing a display panel fabrication line. The apparatus C receives two cassettes each including 40 liquid crystal display panels, fed from the area 81, and relocates totally 80 liquid crystal display panels to an empty cassette to be supplied to the introduction area 82, and further receives the cassette including 80 liquid crystal display panels, fed from the introduction area 82, and relocates 40 liquid crystal display panels to each of two cassettes to be fed to the sealing area 83. Thus, the number of apparatuses and a location at which the apparatus is installed may be selected in dependence on a fabrication yield in a display panel fabrication line.

[0079]

Hereinbelow is explained an operation of the apparatus of relocating display panels, installed in a line of fabricating liquid crystal display panels. In a case explained hereinbelow, it is assumed that the apparatus is installed in a fabrication line illustrated in Fig. 8(a).

First, the panel-containing cassette 22a is transferred to the relocation apparatus A from the dicing area 81. Specifically, the panel-containing cassette

22a in which 40 display panels 21 are accommodated in a length-wise direction of the first apparatus A is positioned in the first station ST1 in the unit 27. The panel-containing cassette 22a is then intermittently transferred successively to the fifth station ST5 by means of an intermittently-transferring unit (not illustrated). The panel-containing cassette 22a is compensated for as to its stop position in the fifth station ST5 by means of the unit 39 formed in the base 33 and a unit of positioning a cassette (not illustrated), formed in the display panel feeder 46.

Then, with reference to Fig. 3, the display panel moving unit 45 located below the fifth station ST5 raises to lower edges of the display panels 21 accommodated in the panel-containing cassette 22a, and thus, supports 40 display panels 21 at lower edges thereof. The comb-shaped plates 58 of the display panel support unit 47 lowers, and inserts combs of the comb-shaped plates 58 into spaces between the display panels 21 at upper edges thereof. Since the unit 26 is inclined about 1 degree towards the unit 25, combs of the comb-shaped plates 58 could be readily inserted into the spaces. Then, the plate 58a slides relative to the plate 58b by a small distance. As a result, a pitch at upper edges of the display panels 21 is uniformized, and the display panels 21 are supported at upper edges thereof. By uniformizing a pitch in such a manner, it is possible to prevent the display panels 21 from making abutment with the grooves 74 of the display panel holder 72 illustrated in Fig. 7, when the display panels 21 are taken out of the cassette or inserted into the cassette, ensuring smooth relocation of the display panels 21 without no breakage of the display panels 21.

[0080]

Then, the display panel moving unit 45 and the display panel support unit 47 concurrently raise with the display panels 21 being supported at lower and upper edges thereof by those units 45 and 47. Then, as illustrated in Fig. 2, the display panel holding unit 48 slides to thereby support the display panels 21

at lower and side edges thereof by the first and second rollers 62 and 63. The pitch compensating unit 49 concurrently slides to thereby cause combs of the comb-shaped plates 69 to be inserted into gaps between the display panels 21 at side edges thereof. Then, the plate 69b slides relative to the plate 69a by a small distance. As a result, a pitch at side edges of the display panels 21 is uniformized. By uniformizing a pitch in such a manner, it is possible to prevent the display panels 21 from making abutment with the grooves 74 of the display panel holder 72 illustrated in Fig. 7, when the display panels 21 are taken out of the cassette or inserted into the cassette, ensuring smooth relocation of the display panels 21 without no breakage of the display panels 21.

As mentioned so far, after the display panels 21 have been supported at upper, lower and opposite side edges thereof, the display panel moving unit 45 lowers. Thus, the display panels 21 are all taken out of the panel-containing cassette 22a at a time. The empty cassette 24b from which the display panels 21 have been taken out is transferred successively to the ninth station ST9, and then, is exhausted from the apparatus of relocating the display panels. The display panel moving unit 45 having lowered moves to a position below the fourteenth station ST14 along a groove formed at the slide guide 54.

[0081]

Then, the display panel feeder 46 slides to a position above the fourteenth station ST14 with the display panels 21 being kept supported in the above-mentioned manner. The empty cassette 24a mounted at the tenth station ST10 is turned by 90 degrees at the twelfth station ST12 by the cassette rotary unit 30, and then, transferred successively to the fourteenth station ST14. Similarly to the panel-containing cassette 22a, the empty cassette 24a is compensated for as to its stop position in the fourteenth station ST14 by means of the unit 39 formed in the base 33 and a unit (not illustrated) of positioning a cassette, formed in the display panel feeder 46. The empty cassette 24a is caused to stop at such a position that when 40 display panels 21 supported above

the fourteenth station ST14 lower, the 40 display panels 21 are accommodated into a half of the empty cassette 24a which half is closer to the eighteenth station ST18.

In the step of accommodating the 40 display panels 21 into the empty cassette 24a, the display panel moving unit 45 having transferred to a position below the fourteenth station ST14 raises to thereby support the display panels 21 at lower edges thereof. Then, after both the display panel holding unit 48 and the pitch compensating unit 49 outwardly slide, the display panel moving unit 45 and the comb-shaped plates 58 of the display panel support unit 47 concurrently lower. Thereafter, the comb-shaped plates 58 are released from the display panels 21, and then, the comb-shaped plates 58 raise. Then, the display panel moving unit 45 lowers. Thus, the 40 display panels 21 are accommodated into the empty cassette 24a at a half thereof.

Then, the empty cassette 24a is forwardly moved by a distance equal to a half of a length of the cassette. Then, 40 display panels 21 accommodated into the next panel-containing cassette 22a having been transferred to the fifth station ST5 are relocated into the empty cassette 24a in the same manner as mentioned above. Thus, 80 display panels 21 are accommodated into the empty cassette 24a, namely, the empty cassette 24a is turned into the panel-containing cassette 22b. The panel-containing cassette 22b containing the 80 display panels 21 is turned by 90 degrees at the sixteenth station ST16, and then, transferred to the eighteenth station ST18. The panel-containing cassette 22b taken out at the eighteenth station ST18 is introduced into the introduction step area 82.

[0082]

In the introduction step area 82, liquid crystal is introduced into the 80 display panels 21 having been accommodated into the panel-containing cassette 22b in the above-mentioned manner. Then, the panel-containing cassette 22b is transferred into the relocation apparatus B. Namely, the panel-containing

cassette 22b is mounted on the first station ST1 in the second apparatus B. The relocation apparatus B has the same structure as that of the relocation apparatus A.

In the relocation apparatus B, the 80 display panels 21 having been accommodated into the panel-containing cassette 24b is relocated into two empty cassettes by every 40 display panels. The step of relocating the display panels 21 in the relocation apparatus B is identical with the step of relocating the display panels 21 in the relocation apparatus A except a slight difference such as the number of rotations of the cassette rotary unit 30 since 40 display panels 21 are relocated in a cycle in the unit 34. Since liquid crystal is adhered to the display panels 21 at lower edges thereof in the introduction step, such liquid crystal is swept from the first rollers 62 and the upper and lower rollers 50a and 50b by means of the sweeper units 43 and 44.

The panel-containing cassette 22b into which 40 display panels 21 have been accommodated in the relocation apparatus B is transferred into the sealing step area 83.

[Advantages obtained by the Invention]

In accordance with the present invention, it is possible in fabrication of a liquid crystal display panel, for instance, to process liquid crystal display panels in a step of introduction of liquid crystal by the unit number greater than both the unit number of liquid crystal display panels in a step of dicing, which is to be carried out immediately before the step of introduction of liquid crystal and the unit number of liquid crystal display panels in a step of sealing, which is to be carried out immediately after the step of introduction of liquid crystal. In addition, it is possible to efficiently relocate display panels.

Hence, even if a conventional fabrication line is used as it is, it would not be necessary to increase the number of apparatuses for introducing liquid crystal into a space formed between substrates, and the fabrication line and other fabrication steps are not necessary to be modified. Hence, it would be possible to

enhance an efficiency in fabrication steps of a liquid crystal display panel and in a fabrication line.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 is a perspective view of an apparatus for relocating a display panel, in accordance with the present invention.

[Fig. 2] Fig. 2 is a perspective view of a unit for relocating a display panel, used in the apparatus in accordance with the present invention.

[Fig. 3] Fig. 3 is a perspective view of a cassette lying on a fifth station in the apparatus in accordance with the present invention.

[Fig. 4] Fig. 4 is a front view of a unit for raising and lowering a display panel in the apparatus in accordance with the present invention.

[Fig. 5] Fig. 5 is a front view illustrating how overlapping comb-shaped plates slide relative to each other in the apparatus in accordance with the present invention.

[Fig. 6] Fig. 6 is a front view of cassettes used in the apparatus in accordance with the present invention.

[Fig. 7] Fig. 7 is a perspective view of a display panel holder plate in a cassette used in the apparatus in accordance with the present invention.

[Fig. 8] Fig. 8 is a block diagram illustrating a relation between an apparatus for relocating a display panel and a display panel fabrication line.

[Fig. 9] Fig. 9 includes a perspective view and a front view of a display panel.

[Fig. 10] Fig. 10 is a block diagram showing a method of fabricating a display panel.

[Fig. 11] Fig. 11 is a cross-sectional view showing a step of introducing liquid crystal into a display panel.

[Indication by Reference Numeral]

21 Display panel

23 Unit for transferring panel-containing cassettes

25 Unit for transferring empty cassettes

26 Unit for relocating display panels

33 Base

34 Unit for relocating display panels

84 Relocation step area

[Document Name] Abstract

[Abstract]

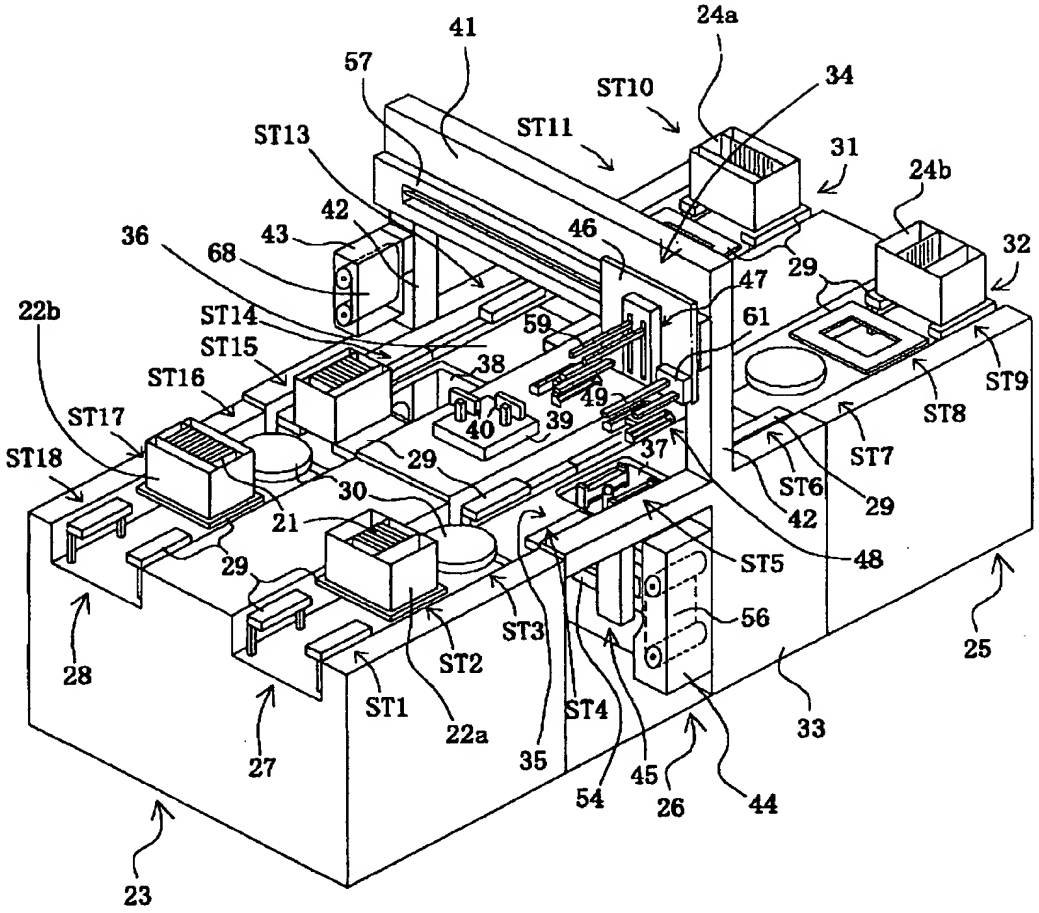
[Object] To provide an apparatus for relocating a display panel and a unit for doing the same both of which are capable of enhancing a fabrication yield in fabrication of display panels and in a fabrication line.

[Solution] The apparatus is comprised of a unit 23 for transferring panel-containing cassettes 22a and 22b containing vertically display panels 21 therein, a unit 25 for transferring empty cassettes 24a and 24b, and a unit 26 for inserting display panels 21 into the empty cassette 24a.

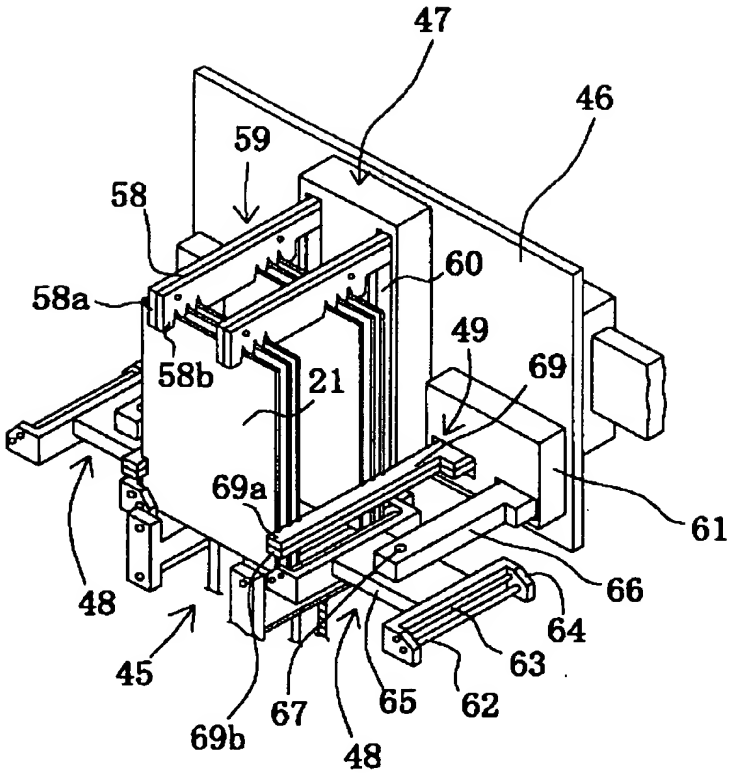
[Representative Drawing] Fig. 1

【Documents Name】 Drawing

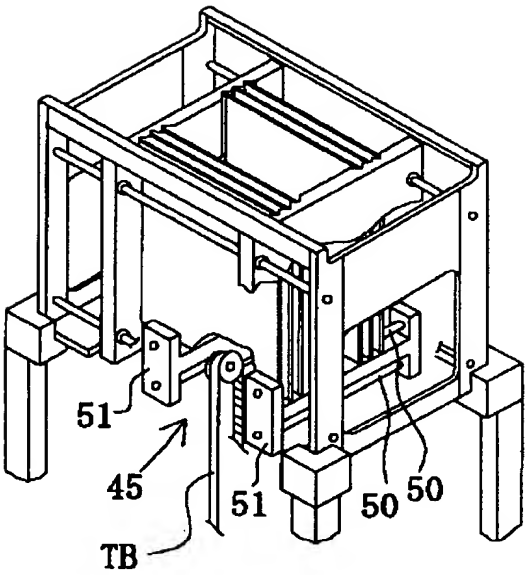
【Fig.1】



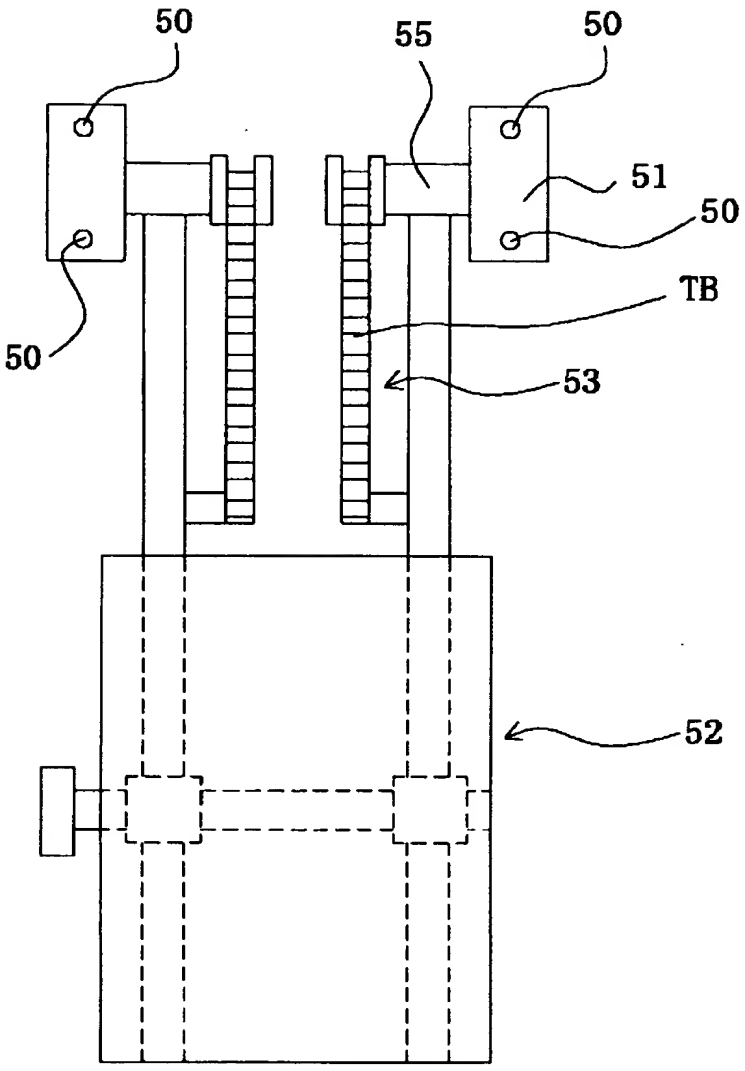
【Fig.2】



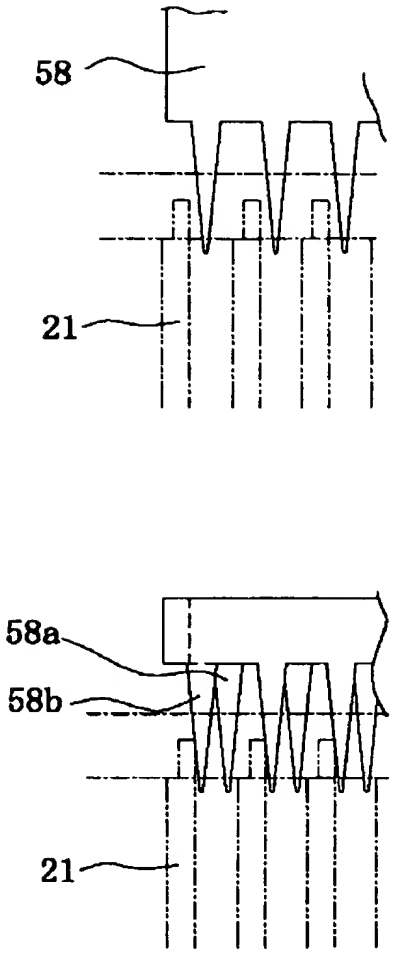
【Fig.3】



【Fig.4】

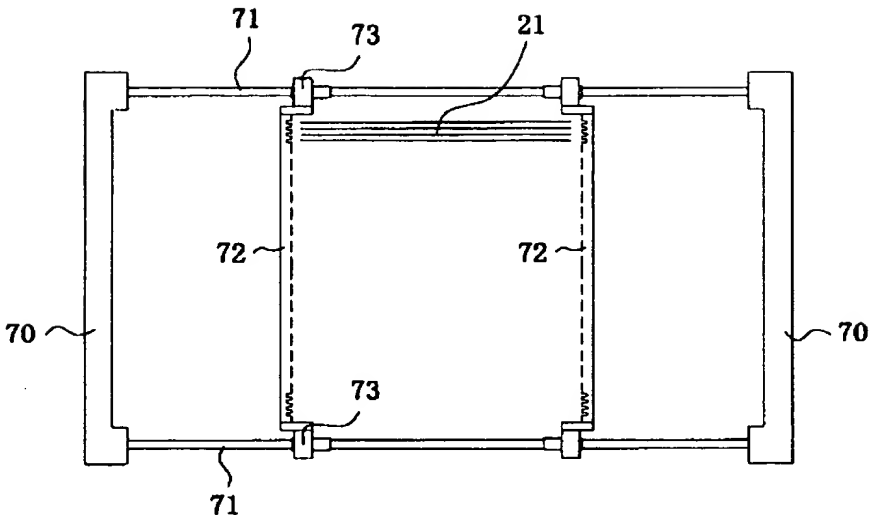


【Fig.5】

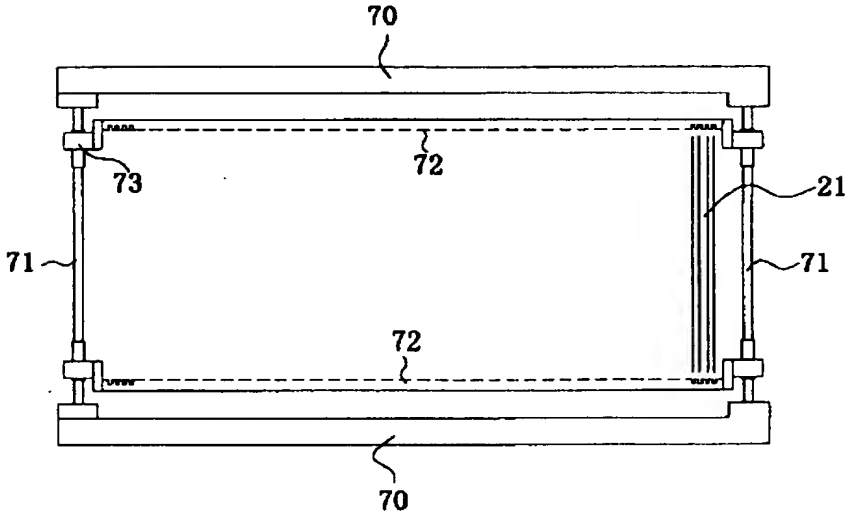


【Fig.6】

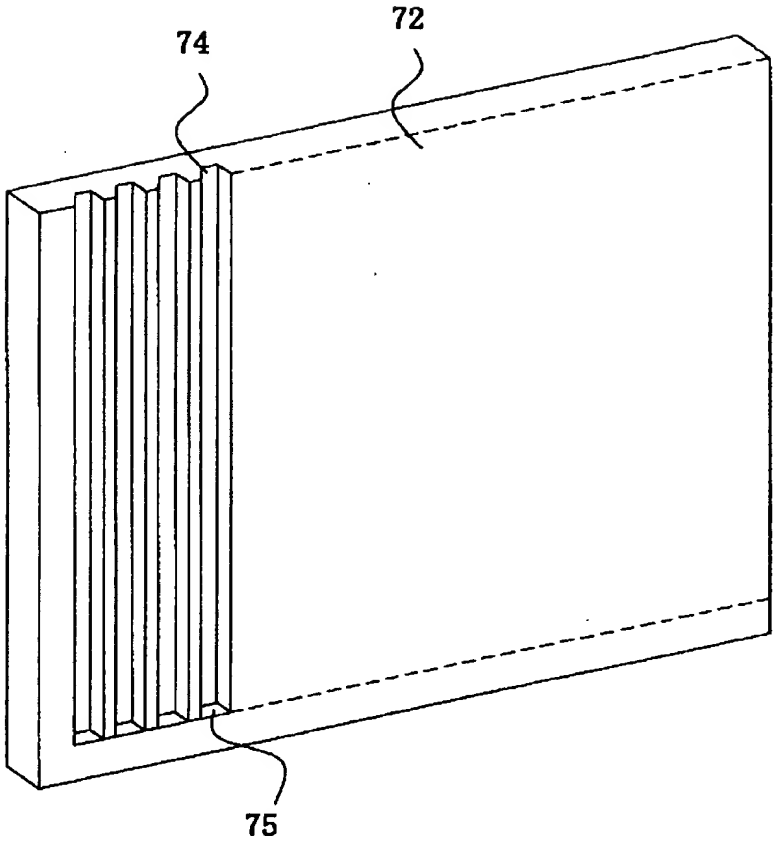
(a)



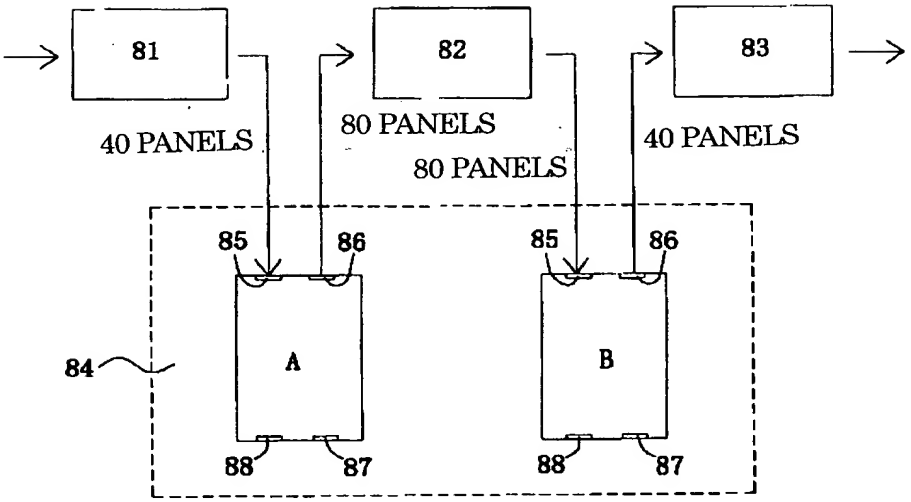
(b)



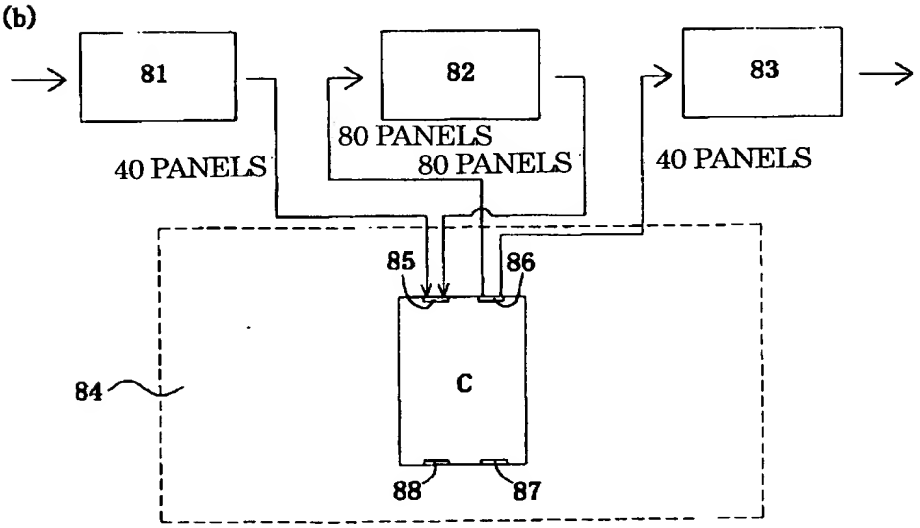
【Fig.7】



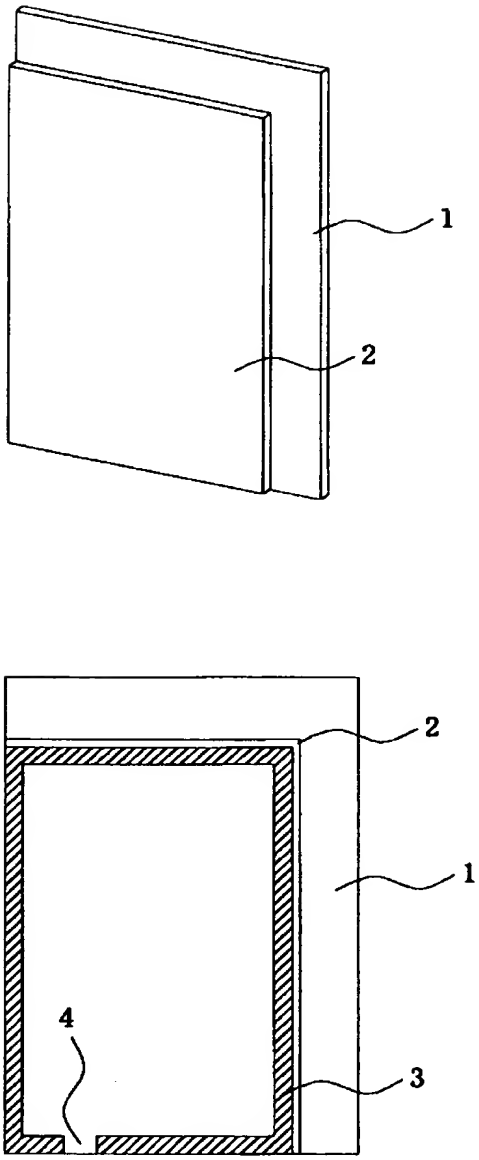
【Fig.8】 (a)



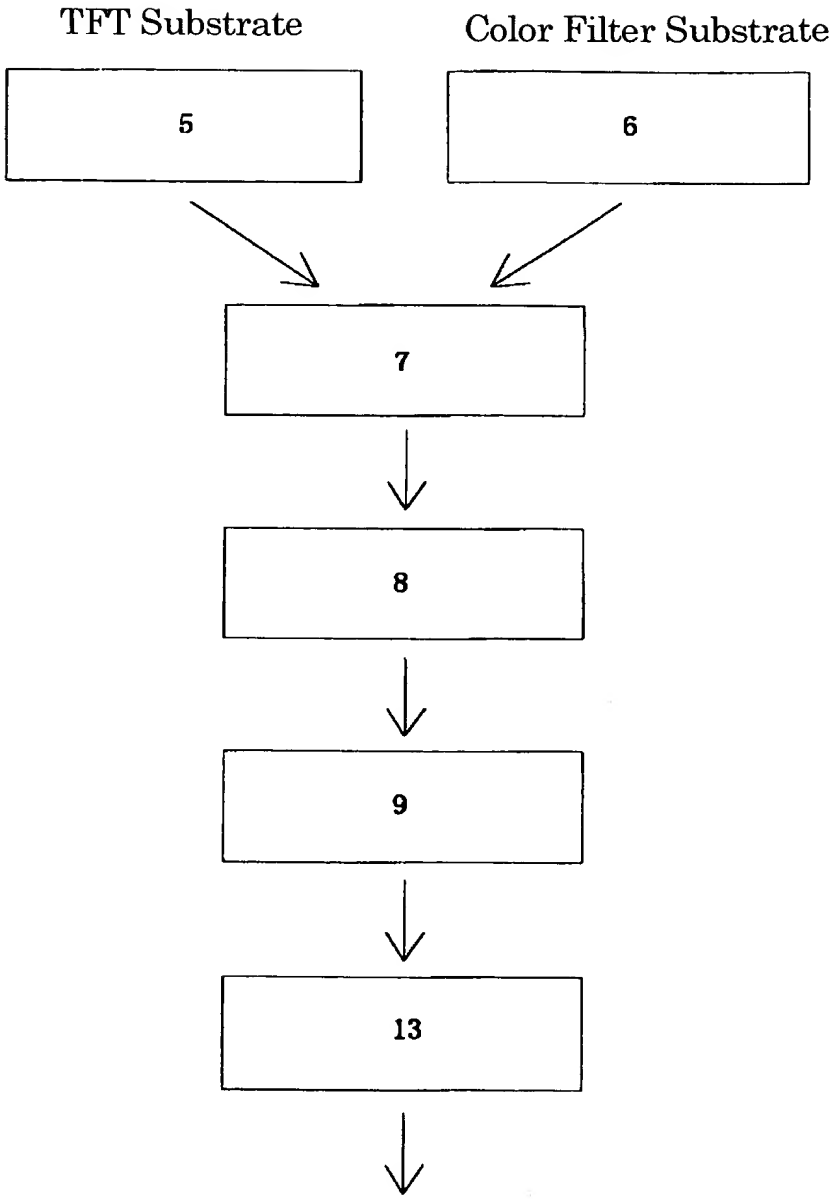
(b)



【Fig.9】



【Fig.10】



【Fig.11】